

What Is Claimed Is:

1. A process for reforming an alcohol, the process comprising:
contacting a feed gas mixture comprising an alcohol with a reforming catalyst comprising copper at the surface of a metal sponge supporting structure to produce a reforming product mixture comprising hydrogen.
2. A process as set forth in claim 1, wherein the feed gas mixture comprises a primary alcohol selected from the group consisting of methanol, ethanol and mixtures thereof.
3. A process as set forth in claim 2, wherein the process further comprises introducing hydrogen from the reforming product mixture and oxygen into a fuel cell to produce electric power.
4. A process as set forth in claim 1, wherein the reforming catalyst has a surface area of from about 10 m²/g to about 100 m²/g as measured by the Brunauer-Emmett-Teller method.
5. A process as set forth in claim 4, wherein the reforming catalyst has a surface area of from about 25 m²/g to about 100 m²/g as measured by the Brunauer-Emmett-Teller method.
6. A process as set forth in claim 5, wherein the reforming catalyst has a surface area of from about 30 m²/g to about 80 m²/g as measured by the Brunauer-Emmett-Teller method.

7. A process as set forth in claim 1, wherein the reforming catalyst comprises at least about 10% by weight copper.

8. A process as set forth in claim 1, wherein the reforming catalyst comprises from about 10% to about 90% by weight copper.

9. A process as set forth in claim 1, wherein the metal sponge supporting structure of the reforming catalyst has a surface area of at least about 10 m²/g as measured by the Brunauer-Emmett-Teller method.

10. A process as set forth in claim 9, wherein the metal sponge supporting structure of the reforming catalyst has a surface area of at least about 50 m²/g as measured by the Brunauer-Emmett-Teller method.

11. A process as set forth in claim 10, wherein the metal sponge supporting structure of the reforming catalyst has a surface area of at least about 70 m²/g as measured by the Brunauer-Emmett-Teller method.

12. A process as set forth in claim 9, wherein the metal sponge supporting structure comprises nickel.

13. A process as set forth in claim 12, wherein the metal sponge supporting structure comprises at least about 50% by weight nickel.

14. A process as set forth in claim 13, wherein the metal sponge supporting structure comprises at least about

85% by weight nickel.

15. A process as set forth in claim 12, wherein the reforming catalyst comprises from about 10% to about 80% by weight copper.

16. A process as set forth in claim 15, wherein the reforming catalyst comprises from about 20% to about 45% by weight copper.

17. A process as set forth in claim 12, wherein the reforming catalyst comprises from about 5 to about 100 $\mu\text{mol/g}$ of nickel at the surface of said catalyst.

18. A process as set forth in claim 17, wherein the reforming catalyst comprises from about 10 to about 80 $\mu\text{mol/g}$ of nickel at the surface of said catalyst.

19. A process as set forth in claim 18, wherein the reforming catalyst comprises from about 15 to about 75 $\mu\text{mol/g}$ of nickel at the surface of said catalyst.

20. A process as set forth in claim 12, wherein the feed gas mixture comprises a primary alcohol selected from the group consisting of methanol, ethanol and mixtures thereof.

21. A process as set forth in claim 12, wherein the process further comprises introducing hydrogen from the reforming product mixture and oxygen into a fuel cell to produce electric power.

22. A process as set forth in claim 1, wherein said feed gas mixture is contacted with said reforming catalyst at a temperature below about 400°C.

23. A process as set forth in claim 1, wherein said feed gas mixture is contacted with said reforming catalyst at a temperature of from about 200°C to about 375°C.

24. A process as set forth in claim 23, wherein said feed gas mixture is contacted with said reforming catalyst at a temperature of from about 250°C to about 325°C.

25. A process as set forth in claim 1, wherein the reforming catalyst is incorporated onto the surface of a pellet or a monolith substrate.

26. A process as set forth in claim 25, wherein the reforming catalyst comprises a nickel sponge supporting structure.

27. A process for reforming ethanol, the process comprising contacting feed gas mixture comprising ethanol with a reforming catalyst at a temperature below about 400°C to produce a reforming product mixture comprising hydrogen,
5 said reforming catalyst comprising copper at the surface of a metal supporting structure.

28. A process as set forth in claim 27, wherein said feed gas mixture is contacted with said reforming catalyst at a temperature of from about 250°C to about 300°C.

29. A process as set forth in claim 27, wherein the

reforming catalyst has a thermal conductivity at 300K of at least about 50 W/m·K.

30. A process as set forth in claim 29, wherein the reforming catalyst has a thermal conductivity at 300K of at least about 70 W/m·K.

31. A process as set forth in claim 30, wherein the reforming catalyst has a thermal conductivity at 300K of at least about 90 W/m·K.

32. A process as set forth in claim 27, wherein the process further comprises introducing hydrogen from the reforming product mixture and oxygen into a fuel cell to produce electric power.

33. A process as set forth in claim 27, wherein the reforming catalyst has a surface area of from about 10 m²/g to about 100 m²/g as measured by the Brunauer-Emmett-Teller method.

34. A process as set forth in claim 33, wherein the reforming catalyst has a surface area of from about 25 m²/g to about 100 m²/g as measured by the Brunauer-Emmett-Teller method.

35. A process as set forth in claim 34, wherein the reforming catalyst has a surface area of from about 30 m²/g to about 80 m²/g as measured by the Brunauer-Emmett-Teller method.

36. A process as set forth in claim 27, wherein the

reforming catalyst comprises at least about 10% by weight copper.

37. A process as set forth in claim 36, wherein the reforming catalyst comprises from about 10% to about 90% by weight copper.

38. A process as set forth in claim 27, wherein the metal supporting structure comprises a metal sponge.

39. A process as set forth in claim 38, wherein the metal sponge supporting structure of the reforming catalyst has a surface area of at least about 10 m²/g as measured by the Brunauer-Emmett-Teller method.

40. A process as set forth in claim 39, wherein the metal sponge supporting structure of the reforming catalyst has a surface area of at least about 50 m²/g as measured by the Brunauer-Emmett-Teller method.

41. A process as set forth in claim 40, wherein the metal sponge supporting structure of the reforming catalyst has a surface area of at least about 70 m²/g as measured by the Brunauer-Emmett-Teller method.

42. A process as set forth in claim 38, wherein the metal sponge supporting structure comprises nickel.

43. A process as set forth in claim 42, wherein the metal sponge supporting structure comprises at least about 50% by weight nickel.

44. A process as set forth in claim 43, wherein the metal sponge supporting structure comprises at least about 85% by weight nickel.

45. A process as set forth in claim 42, wherein the reforming catalyst comprises from about 10% to about 80% by weight copper.

46. A process as set forth in claim 45, wherein the reforming catalyst comprises from about 20% to about 45% by weight copper.

47. A process as set forth in claim 42, wherein the reforming catalyst comprises from about 5 to about 100 $\mu\text{mol/g}$ of nickel at the surface of said catalyst.

48. A process as set forth in claim 47, wherein the reforming catalyst comprises from about 10 to about 80 $\mu\text{mol/g}$ of nickel at the surface of said catalyst.

49. A process as set forth in claim 48, wherein the reforming catalyst comprises from about 15 to about 75 $\mu\text{mol/g}$ of nickel at the surface of said catalyst.

50. A process as set forth in claim 42, wherein the process further comprises introducing hydrogen from the reforming product mixture and oxygen into a fuel cell to produce electric power.

51. A process as set forth in claim 27, wherein the reforming catalyst is incorporated onto the surface of a pellet or a monolith substrate.

52. A process as set forth in claim 51, wherein the reforming catalyst comprises a nickel sponge supporting structure.

53. A process for producing electric power from a fuel cell, the process comprising:

contacting a feed gas mixture comprising ethanol with a dehydrogenation catalyst in a dehydrogenation reaction zone
5 to produce a product mixture comprising hydrogen, wherein said dehydrogenation catalyst comprises copper at the surface of a metal supporting structure;

introducing hydrogen from the product mixture and oxygen into a fuel cell to produce electric power and a fuel
10 cell effluent comprising methane;

introducing the fuel cell effluent and oxygen into a combustion chamber; and

combusting the fuel cell effluent in the combustion chamber.

54. A process as set forth in claim 53, wherein the feed gas mixture further comprises water.

55. A process as set forth in claim 54, wherein the dehydrogenation reaction zone further comprises a water-gas shift catalyst effective for catalyzing the water-gas shift reaction between carbon monoxide produced by the
5 dehydrogenation of ethanol and water to form carbon dioxide and hydrogen.

56. A process as set forth in claim 55, wherein the water-gas shift catalyst is separate from the dehydrogenation catalyst.

57. A process as set forth in claim 53, wherein the process further comprises transferring the heat of combustion produced in the combustion chamber to the dehydrogenation reaction zone.

58. A process as set forth in claim 53, wherein the process further comprises capturing the energy of combustion for the generation of mechanical and/or additional electric power.

59. A process as set forth in claim 58, wherein the energy of combustion from said combustion chamber is used to drive a generator for the production of additional electric power.

60. A process as set forth in claim 58, wherein the dehydrogenation zone and the combustion chamber are part of a vehicular power system and the electric power and/or the mechanical power produced is used to drive the vehicle.

61. A process as set forth in claim 53 further comprising introducing a separate cold start fuel source into the combustion chamber and combusting the separate cold start fuel source in the presence of oxygen.

62. A process as set forth in claim 61, wherein the fuel cell effluent and the cold start fuel source are introduced into a combustion chamber of a flexible fuel source internal combustion engine capable of combusting
5 methane and/or the separate cold start fuel source.

63. A process as set forth in claim 62, wherein the

dehydrogenation zone and the flexible fuel source internal combustion engine are part of a vehicular power system, the process further comprising capturing the energy of
5 combustion for the generation of mechanical and/or additional electric power and using said mechanical power and/or said electric power to drive the vehicle.

64. A process as set forth in claim 53, wherein said feed gas mixture is contacted with said dehydrogenation catalyst at a temperature below about 400°C.

65. A process as set forth in claim 64, wherein said feed gas mixture is contacted with said dehydrogenation catalyst at a temperature of from about 250°C to about 300°C.

66. A process as set forth in claim 53, wherein the dehydrogenation catalyst has a thermal conductivity at 300K of at least about 50 W/m·K.

67. A process as set forth in claim 66, wherein the dehydrogenation catalyst has a thermal conductivity at 300K of at least about 70 W/m·K.

68. A process as set forth in claim 67, wherein the dehydrogenation catalyst has a thermal conductivity at 300K of at least about 90 W/m·K.

69. A process as set forth in claim 53, wherein the dehydrogenation catalyst has a surface area of from about 10 m²/g to about 100 m²/g as measured by the Brunauer-Emmett-Teller method.

70. A process as set forth in claim 69, wherein the dehydrogenation catalyst has a surface area of from about 25 m²/g to about 100 m²/g as measured by the Brunauer-Emmett-Teller method.

71. A process as set forth in claim 70, wherein the dehydrogenation catalyst has a surface area of from about 30 m²/g to about 80 m²/g as measured by the Brunauer-Emmett-Teller method.

72. A process as set forth in claim 53, wherein the dehydrogenation catalyst comprises at least about 10% by weight copper.

73. A process as set forth in claim 72, wherein the dehydrogenation catalyst comprises from about 10% to about 90% by weight copper.

74. A process as set forth in claim 53, wherein the metal supporting structure of the dehydrogenation catalyst comprises a metal sponge.

75. A process as set forth in claim 74, wherein the metal sponge supporting structure of the dehydrogenation catalyst has a surface area of at least about 10 m²/g as measured by the Brunauer-Emmett-Teller method.

76. A process as set forth in claim 75, wherein the metal sponge supporting structure of the dehydrogenation catalyst has a surface area of at least about 50 m²/g as measured by the Brunauer-Emmett-Teller method.

77. A process as set forth in claim 76, wherein the metal sponge supporting structure of the dehydrogenation catalyst has a surface area of at least about 70 m²/g as measured by the Brunauer-Emmett-Teller method.

78. A process as set forth in claim 74, wherein the metal sponge supporting structure comprises nickel.

79. A process as set forth in claim 78, wherein the metal sponge supporting structure comprises at least about 50% by weight nickel.

80. A process as set forth in claim 79, wherein the metal sponge supporting structure comprises at least about 85% by weight nickel.

81. A process as set forth in claim 78, wherein the dehydrogenation catalyst comprises from about 10% to about 80% by weight copper.

82. A process as set forth in claim 81, wherein the dehydrogenation catalyst comprises from about 20% to about 45% by weight copper.

83. A process as set forth in claim 81, wherein the dehydrogenation catalyst comprises from about 5 to about 100 μ mol/g of nickel at the surface of said catalyst.

84. A process as set forth in claim 83, wherein the dehydrogenation catalyst comprises from about 10 to about 80 μ mol/g of nickel at the surface of said catalyst.

85. A process as set forth in claim 84, wherein the dehydrogenation catalyst comprises from about 15 to about 75 $\mu\text{mol/g}$ of nickel at the surface of said catalyst.

86. A process as set forth in claim 53, wherein the dehydrogenation catalyst is incorporated onto the surface of a pellet or a monolith substrate.

87. A process as set forth in claim 39, wherein the dehydrogenation catalyst comprises a nickel sponge supporting structure.